FRD Activities Report
July 2003

Research Programs

Joint Urban 2003

Field measurements for the Joint Urban 2003 Tracer Study continued during the month of July. In addition to FRD, ARL's Atmospheric Turbulence and Diffusion Division, Argonne National Laboratory, Pacific Northwest National Laboratory, Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Los Alamos National Laboratory, U. S. Army Dugway Proving Ground, Aberdeen Proving Ground, Army Research Laboratory, the University of Oklahoma, the University of Utah, Arizona State University, and others participated, making this a truly multi agency effort.

Ten Intensive Operation Periods (IOPs) were conducted during the month of July in the downtown region of Oklahoma City. Sulfur hexafluoride was released both in puffs and with a continuous release system mounted in a U-Haul van. These mobile release systems made it possible to conduct IOPs utilizing four different release points for winds coming from the southwest, south, and southeast. Figure 1 shows a balloon containing a known amount of tracer for a puff release; Figure 2 shows the continuous release system.

Figure 1. Balloon filled with tracer just prior to manual bursting for a puff release.

Figure 2. Continuous tracer release mechanism installed in a U-Haul moving van.

Approximately 195 Programmable Integrated Gas Samplers (PIGS) each containing 12 sample bags were deployed in a grid system, including on top of buildings and in the underground tunnel system, and in arcs at one, two, and four kilometers from the release point. Figure 3 shows Kirk Clawson removing a sampler from a rooftop. (Staff)

Figure 3. Kirk Clawson removing rooftop sampler.

Immediately following an IOP, the sample cartridges were collected for analysis. The Automated Tracer Gas Analysis System (ATGAS) functioned almost flawlessly during the laboratory analysis of the cartridges filled using the PIGS. One ATGAS needed column replacements due to a timing error for the back flush of the oxygen peak. This error was corrected about halfway through the project and the instrument had no other issues. Another ATGAS had intermittent baseline noise at certain voltage outputs. The problem was not able to be fixed in the field due to time constraints, but the ATGAS was still fully functional for lower concentration levels where most of the sample concentrations fell.

For each IOP, 195 sample cartridges containing 12 bags each were analyzed for a total sample number of 2,340. This number does not include the calibration and laboratory quality control (QC) that is also associated with each IOP. The total number of data points for the project is well over 23,000. Due to many months of pre-planning, we were able to analyze all samples and their associated QC, have the data verified by a second analyst, rerun any samples that were inadvertently missed or had QC issues, re-clean all 195 cartridges, analyze every 6th cleaned cartridge and move the cartridges back to the staging area for future use, all in approximately 3-4 days time, an amazing accomplishment considering the sheer number of data points. (debbie@noaa.inel.gov)

Figure 4. ATGAS Laboratory (data computer)

Figure 5. ATGAS Laboratory (all 4 instruments)

In addition to the PIGS, ten continuous SF_6 analyzers were operated during each intensive

observation period, more than FRD has ever operated in the past. Nine of the analyzers were stationary during the releases and one was mobile. Because of the short range nature of the experiment, the analyzers were tuned for their maximum dynamic range of 0 to 20,000 ppt SF_6. This made it difficult for some of the analyzers to make reliable measurements at very low concentrations (0 to 100 ppt). However, most of the plume observations peaked at several thousand ppt so lack of sensitivity at the low concentrations should not be a problem.

Analyzer operators included FRD employees, retirees from FRD, the INEEL, and DoD, and college students. All operators worked very well together and operated the analyzers very professionally. They performed double duty as both continuous analyzer operators and PIGS servicers. They deserve much of the credit for making this a successful experiment.

About 30 percent of the continuous analyzer data has been reviewed. Completion of the data review process should take several more weeks. We are confident that the continuous analyzers will provide a quality data set that will complement the PIGS data and will be used for many years by many researchers. (roger@noaa.inel.gov)

TGA operations were coordinated at the Operations Center during all IOPs by Kirk Clawson. Figure 6 shows Kirk talking to a TGA operator. He recorded operator's name, location, time, concentration of the peak, and other miscellaneous information. A composite of the calls showed the movement and concentration of the plume. These data were immediately shared with other Operations Center personnel and with other participant in the field. The data were used to monitor the tracer plume in real-time, coordinate other participants' efforts, and to re-deploy real-time analyzers as necessary to properly sample the tracer plume. (debbie@noaa.inel.gov and staff)

Figure 6. Kirk Clawson taking a call from a TGA Operator.

On July 16th, FOX News interviewed several project participants and filmed much of the equipment for a television special on bioterrorism that will air in September. Figure 7 shows the film crew interviewing Kirk Clawson. Figure 8 shows the cameraman filming a continuous tracer analyzer in operation during an IOP. (debbie@noaa.inel.gov)

Figure 7. FOX News Crew interviewing Kirk Clawson.

ET

Figure 8. FOX News camera man filming the operation of a continuous tracer analyzer.

ET Probe

Several intercomparisons have been made between the ET probe and a sonic anemometer using data collected on 15 May 2003. Figure 9 shows traces of velocity components and temperature during the period 1130-1200 MST. The velocity components are in pretty good agreement, with the ET probe measuring a mean wind speed of 8.2 m s^{-1}, compared with 7.4 m s^{-1} for the sonic. Since the ET probe was mounted at about 3 m AGL and the sonic was at 2 m AGL, the difference in the mean winds appears reasonable. The sample variance of the vertical velocity component *w* was 0.81 m^2 s^{-2} for the probe and 0.57 m^2 s^{-2} for the sonic. In a convective boundary layer, this variance should vary with height AGL to the 2/3 power, so the 40% difference in the *w* variances is close to the 30% difference expected from theory. The sonic temperature in Figure 9 shows more variability than the ET temperature. However, the temperature variance is expected to vary with height to the -2/3 power in a convective boundary layer, so the smaller variance for the ET probe is in-line with theory.

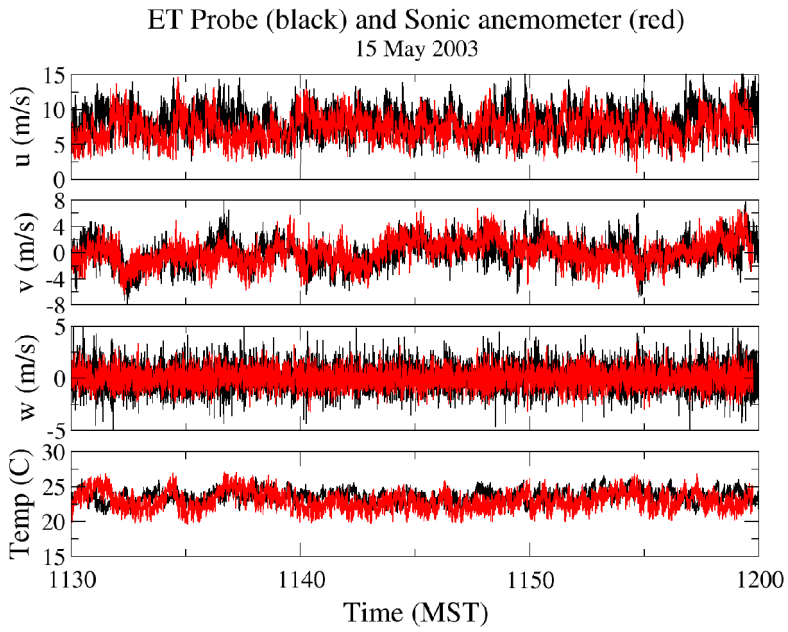

Figure 9. Plots of ET probe and sonic anemometer velocity components and temperature for 1130-1200 MST on 15 May 2003.

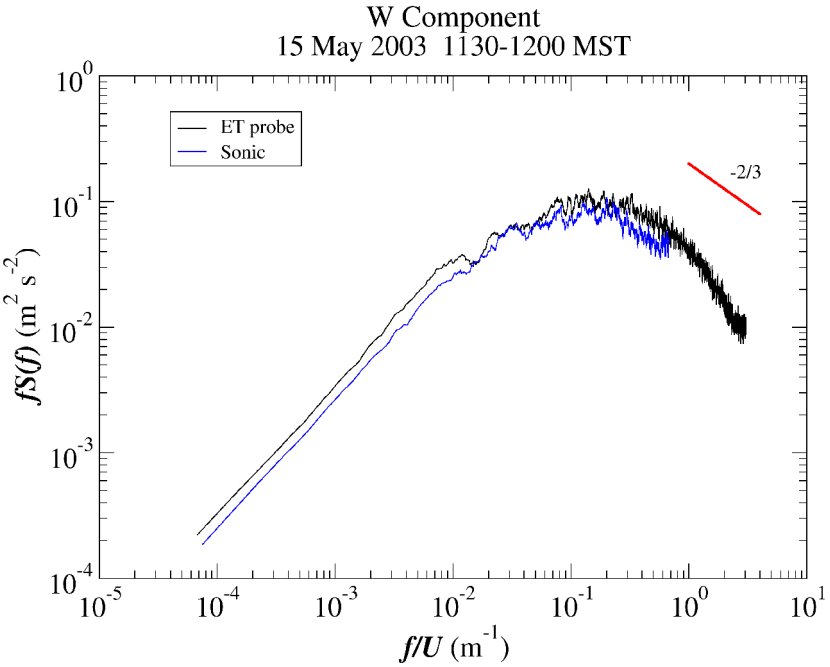

Figure 10. Power spectra for the ET probe and sonic vertical velocity data shown in Figure 9.

Figure 10 shows the power spectra for the *w* component from each instrument. They are in good agreement, with the ET probe being slightly higher due to its greater height AGL. At higher frequencies the ET probe spectrum decreases at a rate greater than the - 2/3 slope expected from inertial-subrange theory. This was observed to be true of the spectra from all three velocity components. Wind estimates from pressure-sphere anemometers like the ET probe are derived from potential-flow theory, so empirical corrections are generally required to account for differences between potential flow and real flow over a sphere. No such corrections were applied to the ET data shown here, and this may explain the rapid rolloff of the velocity spectra.

Another issue considered during July was the estimation of confidence intervals for both the sonic and ET probe turbulence statistics. Conventional statistical approaches assume that all the velocity samples are independent and identically distributed, which is clearly not true for velocity measurements. An alternate approach was tested in July based on the Bayesian Monte Carlo Markov Chain (MCMC) modeling. The advantage of this approach is that one can use a statistical model that accounts for autocorrelations in the data. Initial results with the MCMC modeling have been highly encouraging. For example, conventional statistics for the sonic data in Figure 9 give a 95% confidence interval for the mean wind speed that ranges ±3 cm s^{-1} about the central point estimator. When the data autocorrelations are accounted for with MCMC modeling, the 95% confidence interval is four times larger at ±12 cm s^{-1}. The use of an autoregressive model also has significant effects on some of the turbulence statistics, including the sensible heat flux. Further investigations are under way to understand the different statistical inferences obtained with the autoregressive MCMC models. (Richard.Eckman@noaa.gov)

CBLAST-High

Final preparations were made for the upcoming field experiment. Test flights are scheduled for early August of the BAT system on the NOAA P-3. Continuing preparations for this years experiment include being able to provide data to other CBLAST investigators within hours of the end of the flight. This requires a good deal of coordination between various investigators, as much of the processing of data from the various systems (the BAT included) requires measurements from other instruments on the aircraft. The CBLAST-hurricane website that provides information about various experiments and will serve as the repository for the data collected this year is located at: http://cblast.ecs.unmass.edu. (Jeff.French@noaa.gov.)

Smart Balloon Research

Research is being done to find a high energy to weight ratio solar cell to charge the lithium ion batteries used in the smart balloon transponder package. A possible source for this type of solar cell is Iowa Thin Film and their thin flexible solar cells. Figure 11 shows an example of a 4.8 volt, 100 mA solar cell. The solar cell is only 5.75 in. long, by 3.75 in. wide, 0.008 in. thick with a weight of only 4.5 grams. One of the units described above has been purchased and is being tested

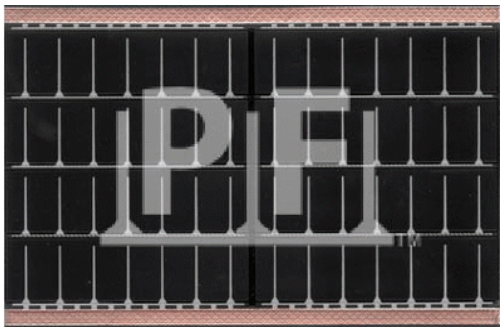

Figure 11. Iowa Thin Film solar cell.

with the rechargeable Sony Energytec lithium ion batteries used in the smart balloon transponder. (Randy.Johnson@noaa.gov)

BRACE

There will be a BRACE Special session titled, "Atmospheric Nitrogen Deposition to Critical Estuary Habitats: The Bay Regional Atmospheric Chemistry Experiment (BRACE)", at the Fall 2003 AGU meeting in San Francisco. Noreen Poor and Tom Watson will convene the session. Electronic abstracts for papers are due to AGU by September 4th.

The processing of the BRACE aircraft data are continuing. A data set consisting of plots of data for all flight tracks was distributed to participants in July. Work on analysis of the data is continuing. There will be at least three abstracts submitted to the Special Session from the BRACE Twin Otter Team. (tom.watson@noaa.gov)

Cooperative Research with INEEL

Emergency Operations Center (EOC)

The EOC was activated on July 3 due to a vague threat to the DOE North facility, a building in Idaho Falls that houses mainly personnel involved in administrative functions. Employees of that building were sent home. The EOC remained activated for the afternoon until the facility was searched and secured for the weekend. (Jeff.French@noaa.gov)

The EOC was again activated July 19 for a wildfire southeast of ANL-West. The fire burned approximately 500 acres near the road just to the north of Highway 20. Several power poles were destroyed and Highway 20 was closed for four hours. The cause of the fire was unknown. (Jeff.French@noaa.gov)

INEEL Support

With most of the FRD staff in Oklahoma City for the Urban 2003 experiment, the INEEL support duties fell on the few remaining staff members. The drought situation in the region has increased the number of requests for historical precipitation data from the INEEL Mesonet. During July such requests were received both from INEEL and from local governments. One request involved the extraction of several years of precipitation data from the Mesonet towers located in Jefferson County, Idaho. Another involved RWMC precipitation data going back to 1995. (Richard.Eckman@noaa.gov)

Nuclear Energy-Idaho Deputy Director

DOE-ID announced that John Kotek has been selected as the NE-Idaho Deputy Manager. His focus will be on the future Nuclear Energy mission for the INEEL, particularly in the area of research and development. As advanced Reactors Program Manager at Argonne National

Laboratory West, he directed participation in the Generation IV program, an international effort focused on developing the next generation of nuclear power reactors, and managed Argonne's research program on the use of nuclear energy for the production of hydrogen. (Joyce.Silvester@noaa.gov)

Other Activities

OGP Proposals

ARLFRD submitted two proposals to the NOAA Office of Global Program Climate and Global Change 2003 RFP. They were titled, "Midwest Tower and Airborne Flux Program," submitted to the Global Carbon Cycle Element and, "Land-Surface Interactions: Soil Moisture, Surface Variability, and Boundary Layer Dynamics in the North American Monsoon Core Region," submitted to the PACS-GAPP North American Warm Season Precipitation program element. (tom.watson@noaa.gov)

Travel

Kirk Clawson, Tom Watson, Roger Carter, Debbie Lacroix, Neil Hukari, and contractors Shane Beard, Tom Strong, Ryan Walker, Mark Hoover, Dianne Hoover, Sean Eldredge, Chris Biltoff, and Camille Erwin all started the month in travel status as they continued working on the Joint Urban 2003 Tracer Project in Oklahoma City. The project concluded on July 31.

Randy Johnson to Oklahoma City July 8-13 for the Joint Urban 2003 Tracer Project.

Tom Watson to Boulder, Colorado, July 20-27 for the Air Quality Forecasting Meeting.

Training

Nine FRD personnel completed the mandatory On-line Safety Training. (paula.fee@noaa.gov)

Visitors

On July 8, Robert Sellers and Terry Julian of the INEEL< met with Paula Fee to discuss the guidelines for preparing the FLY-04 Work Package Document. This document describes the services we require from the INEEL M&O contractor, such as phones, vehicles, supplies, printing, graphic arts, training, etc. (paula.fee@noaa.gov)

Budget

We were notified by DOE that the FY-04 funding for the M&O contractor services referred to by DOE as indirect funding will be added to our FY-04 Interagency Agreement. They also informed us that the indirect funding may be cut by $45K mainly because of the cost savings for not using the services of their M&O contractor. A response to DOE was submitted stating the reasons why

we cannot operate at the same level of effort with the proposed decrease in the indirect funding. (paula.fee@noaa.gov)